PATENT ABSTRACTS OF JAPAN

(11)Publication number :　　　　　2000-137305

(43)Date of publication of application : 16.05.2000

(51)Int.CI.	G03B 27/73
	H04N 1/60
	H04N 1/46

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(54) METHOD AND DEVICE FOR CORRECTING COLOR

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a color correcting method and a color correcting device by which a print whose gray balance and color reproduction are properly corrected can be obtained from a photosensitive material such as a negative film exposed by a different-type light source being remarkably different from a proper light source.

SOLUTION: By this method and this device, a first conversion process that density data photoelectrically read from a picture photographed on the photosensitive material is converted into the density data without receiving an overlapping layer effect, a second conversion process that the converted density data is converted into exposure data, a process that the deviation of exposure between the proper light source and the different-type light source is adjusted as to the converted exposure data, a first inverse conversion process that the density data is obtained by inversely converting the adjusted exposure data to the second conversion process and a second inverse conversion process that the density data being equal to the image data obtained when the photosensitive material exposed by the proper light source is read by inversely converting the inversely converted density data to the first conversion process is obtained are executed.
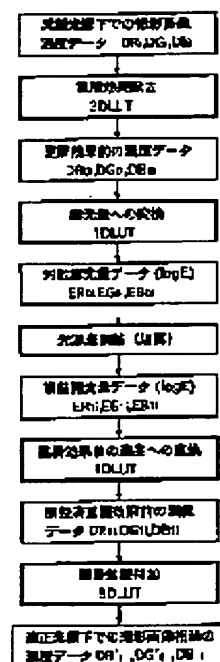
LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision
of rejection]
[Date of requesting appeal against examiner's
decision of rejection]
[Date of extinction of right]

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CLAIMS

[Claim(s)]
[Claim 1] The color-correction method characterized by providing the following. The 1st conversion process which changes into concentration data before receiving an interlayer effect the concentration data read from the picture photoed by sensitive material in photoelectricity The 2nd conversion process which changes the changed concentration data into light exposure data The process which adjusts a gap of the light exposure of the proper light source and the different-species light source in the changed light exposure data In this way, the 2nd inverse transformation process which obtains concentration data equivalent to the 1st inverse transformation process which performs inverse transformation of the aforementioned 2nd conversion process to the obtained adjustment light exposure data, and obtains concentration data, and the concentration data obtained when the sensitive material which performed inverse transformation of the aforementioned 1st conversion process to this concentration data transformed inversely, and was photoed with the aforementioned proper light source is read
[Claim 2] the [the aforementioned 1st conversion process and] -- the color-correction method according to claim 1 characterized by using the same 3-dimensional look-up table for 2 inverse transformation processes
[Claim 3] the [the aforementioned 2nd conversion process and] -- the color-correction method according to claim 1 or 2 characterized by using the same 1-dimensional look-up table corresponding to the characteristic curve of the aforementioned sensitive material for 1 inverse transformation process
[Claim 4] A gap of the aforementioned light exposure is the color-correction method according to claim 1 to 3 by which it is characterized [which is the light exposure difference of the aforementioned proper light source and the aforementioned different-species light source].
[Claim 5] The aforementioned light exposure difference is the color-correction method according to claim 4 by which it is characterized [which is a light exposure difference when evaluating the aforementioned proper light source and the aforementioned different-species light source based on the spectral sensitivity of the aforementioned sensitive material].
[Claim 6] Have the following and the concentration data read the account of before are changed into the aforementioned light exposure data which have not received the aforementioned interlayer effect by the aforementioned 1st conversion means and the aforementioned 2nd conversion means. In the obtained light exposure data, the aforementioned adjustment means adjusts a gap of the aforementioned light exposure. in this way, the obtained adjustment light exposure data -- the [the aforementioned 2nd conversion means and] -- the color-correction equipment which performs inverse transformation by 1 conversion means one by one, and is characterized by obtaining concentration data equivalent to the concentration data obtained when the aforementioned color sensitive material photoed with the aforementioned proper light source is read A 1st conversion means to perform bidirectional data conversion between concentration data before receiving the concentration data and the interlayer effect which were read from the picture photoed by sensitive material in photoelectricity A 2nd conversion means to perform bidirectional data conversion between concentration data before receiving the aforementioned interlayer effect, and light exposure data A means to adjust a gap of the light

exposure of the proper light source and the different-species light source in the aforementioned light exposure data

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[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the color-correction
method for the picture which maintained gray balance like the picture photoed with the proper
light source, especially a color picture obtaining the print reproduced good from the picture
photoed with the different-species light source which shifted from the proper light source to
sensitive material, such as a negative film, and equipment.
[0002]
[Description of the Prior Art] Usually, as a color reproduction becomes the optimal to the proper
light source, as for sensitive material, such as a negative color film, the design of an interlayer
effect is made. Therefore, when printing the color picture photoed by sensitive material by
proper exposure under the proper light source by the usual photograph printer, the optimal print
picture of the color reproduction which maintained gray balance can be acquired.
[0003] However, usually [when extreme and a photograph is taken / the different-species light
source which separated remarkably from the proper light source, for example, the light source
with high color temperature, a fluorescent lamp, and / to sensitive material, such as a negative
color film, with this premise calyx gap and such the different-species light source to the
tungsten light source etc., in case an interlayer effect is applied too much and reproduces the
photoed picture by the color] a color reproduction is distorted. For this reason, if the picture
photoed under the different-species light source is reproduced as it is, by the picture photoed
with the tungsten light source, redness will be strong and the strong print of a tint, like
greenishness is strong will be obtained by the picture photoed by the fluorescent lamp, for
example. Such a print is not restricted to the special different-species light source, for example,
when days, such as cloudiness, also have high color temperature, it happens similarly, and if a
photography picture is reproduced as it is, the strong print of blueness will be obtained.
[0004] for this reason -- the conventional technology -- methods, such as a large area
transmittance factor density (LATD) of a photography picture, -- the tint of a print -- an
amendment -- things are performed namely, the thing for which LATD of the photography
picture under the proper light source is compared, and only the part of a gap of the tint in a print
shifts LATD of the photography picture under the different-species light source -- the tint of a
print -- an amendment -- things are performed However, when the print which maintained gray
balance with such conventional technology is created, even if it is exactly good amendment, for a
gray, for each color, amendment is too strong, or it will be too weak and a satisfactory color
reproduction will be obtained.
[0005] That is, since from a highlight to [whole] a shadow shifts by the analog printer, gray
balance can be maintained in the middle gray field. However, since gradation change cannot be
performed by the analog printer, in a highlight field or a shadow field, it is difficult to obtain the
print which could not lose a tint completely but maintained gray balance from the highlight to the
shadow. On the other hand, although processing for every pixel was completed, and obtaining the
print which maintained gray balance in the whole region from a highlight to a shadow was
completed comparatively easily in the digital printer even if it was the color picture photographed

under the different-species light sources, such as the light source with high color temperature, and a fluorescent lamp, since gradation change was possible, the color reproduction had the fault of the color whose red could not amend well, for example, was darkly depressed reappearing.
[0006]
[Problem(s) to be Solved by the Invention] The purpose of this invention cancels the trouble of the above-mentioned conventional technology, and is to offer the color-correction method and equipment which can obtain the print with which both gray balance and the color reproduction were amended appropriately from sensitive material, such as a negative film photoed with the different-species light source which separated remarkably from the proper light source.
[0007]
[Means for Solving the Problem] The 1st conversion process which changes into concentration data before receiving an interlayer effect the concentration data read in photoelectricity from the picture by which this invention was photoed by sensitive material in order to solve the above-mentioned purpose, The 2nd conversion process which changes the changed concentration data into light exposure data, and the process which adjusts a gap of the light exposure of the proper light source and the different-species light source in the changed light exposure data, In this way, the 1st inverse transformation process which performs inverse transformation of the aforementioned 2nd conversion process to the obtained adjustment light exposure data, and obtains concentration data, The color-correction method characterized by having the 2nd inverse transformation process which obtains concentration data equivalent to the concentration data obtained when the sensitive material which performed inverse transformation of the aforementioned 1st conversion process to this concentration data transformed inversely, and was photoed with the aforementioned proper light source is read is offered.
[0008] here -- the [the aforementioned 1st conversion process and] -- as for 2 inverse transformation processes, it is desirable to use the same 3-dimensional look-up table the [moreover, / the aforementioned 2nd conversion process and] -- as for 1 inverse transformation process, it is desirable to use the same 1-dimensional look-up table corresponding to the characteristic curve of the aforementioned sensitive material Moreover, as for a gap of the aforementioned light exposure, it is desirable that it is the light exposure difference of the aforementioned proper light source and the aforementioned different-species light source, and, as for this light exposure difference, it is desirable that it is a light exposure difference when evaluating the aforementioned proper light source and the aforementioned different-species light source based on the spectral sensitivity of the aforementioned sensitive material.
[0009] Moreover, a 1st conversion means to perform bidirectional data conversion between concentration data before this invention receives the concentration data and the interlayer effect which were read from the picture photoed by sensitive material in photoelectricity, A 2nd conversion means to perform bidirectional data conversion between concentration data before receiving the aforementioned interlayer effect, and light exposure data, It has a means to adjust a gap of the light exposure of the proper light source and the different-species light source in the aforementioned light exposure data. The concentration data read the account of before are changed into the aforementioned light exposure data which have not received the aforementioned interlayer effect by the aforementioned 1st conversion means and the aforementioned 2nd conversion means. In the obtained light exposure data, the aforementioned adjustment means adjusts a gap of the aforementioned light exposure. Inverse transformation by 1 conversion means is performed one by one. in this way, the obtained adjustment light exposure data -- the [the aforementioned 2nd conversion means and] -- The color-correction equipment characterized by obtaining concentration data equivalent to the concentration data obtained when the aforementioned color sensitive material photoed with the aforementioned proper light source is read is offered.
[0010]
[Embodiments of the Invention] The color-correction method and equipment concerning this invention are explained in detail below based on the suitable operation gestalt shown in an

attached drawing.

[0011] the state before the place by which it is characterized [of this invention] receives an interlayer effect for the image information (concentration data) obtained from sensitive material, such as a negative color film, by picture readers, such as a scanner, -- changing -- the difference in the light source -- an amendment -- it is in things In the state before receiving this interlayer effect, it can amend by adding the difference in the light source, and the light exposure difference when being able to amend easily especially the difference between the proper light source and the different-species light source, for example, seeing both the light sources with the spectral sensitivity of sensitive material to all image information (all concentration data). In this way, after amending the difference in the light source in the state before receiving an interlayer effect, by pulling back by the environment of the proper light source from the environment of the different-species light source, and giving an interlayer effect again, the tint resulting from the photography under the different-species light source can be lost, and the print with which both gray balance and the color reproduction were amended appropriately can be obtained.

[0012] Drawing 1 is a flow chart which shows an example of the color-correction method concerning this invention. As shown in this drawing, by the color-correction method of this invention In the 1st conversion process, from the picture photoed by sensitive material under the different-species light source first The concentration data (DRi, DGi, and DBi) read in photoelectricity by picture readers, such as a scanner, are changed by the 3-dimensional look-up table (henceforth 3DLUT) for removing an interlayer effect as follows (phi3D). The concentration data (DR0i, DG0i, DB0i) of the state before receiving the interlayer effect from which the interlayer effect was removed are obtained.

(DRi, DGi, and DBi) ->phi3D-> (DR0i, DG0i, DB0i)

Here, conversion phi3D expresses 3DLUT conversion.

[0013] In the 2nd conversion process, next, the concentration data in front of the interlayer effect acquired in this way (DR0i, DG0i, DB0i) as follows -- every color (R, G, B) -- three 1-dimensional look-up tables for light exposure conversion (henceforth 1DLUT) -- using -- respectively -- conversion (phiR, phiG, and phiB) -- carrying out -- a logarithm -- light exposure data (logER0i, logEG0i, logEB0i) are obtained

logER0 i->phi R ->DR0ilogEG0 i->phi G ->DG0ilogEB0 i->phi B ->DB0i -- here -- phiR, phiG, and phiB 1DLUT conversion of each colors R, G, and B is expressed, respectively.

[0014] then, the logarithm acquired in this way in the light source difference adjustment process -- light exposure data (logER0i, logEG0i, logEB0i) -- as follows -- each color (R, G, B) of every -- the light exposure difference of the different-species light source and the proper light source -- in addition, the adjusted new logarithm equivalent to the photography under the proper light source -- it changes into light exposure data (logER1i, logEG1i, logEB1i)

logER1 i=logER0 i+delta logERlogEG1 i=logEG0 i+delta logEGlogEB1 i=logEB0 i+delta logEB -- here, deltalogER, deltalogEG, and deltalogEB express the light exposure difference of the different-species light source of each colors R, G, and B, and the proper light source, respectively

[0015] next, the logarithm of a light source difference adjustment acquired in this way in the 1st inverse transformation process -- light exposure data (logER1i, logEG1i, logEB1i) It transforms inversely, respectively, using again three 1DLUT(s) for light exposure conversion (phiR, phiG, and phiB) used for conversion to the light exposure mentioned above, and concentration data (DR1i, DG1i, DB1i) without the interlayer effect of a light source difference adjustment are obtained.

DR1i-> tphiR ->logER1iDG1i-> tphiG ->logEG1iDB1i-> tphiB ->logEB1i -- here tphiR , tphiG , tphiB 1DLUT inverse transformation of each colors R, G, and B is expressed, respectively.

[0016] It transforms inversely using again 3DLUT (phi3D) which used the concentration data (DR1i, DG1i, DB1i) which finally do not have the interlayer effect of the light source difference adjustment obtained in this way in the 2nd inverse transformation process for the interlayer effect removal mentioned above, and there is an interlayer effect by the light source difference adjustment, namely, the picture concentration data (DR'i, DG'i, and DB'i) which are equivalent to photography under the proper light source are obtained.

(DR1i, DG1i, DB1i) -> tphi3D-> (DR'i, DG'i, and DB'i)

Here, it changes. tphi3D expresses 3DLUT inverse transformation.

[0017] In this way, concentration data equivalent to the concentration data obtained when the picture of the sensitive material photoed under the proper light source is read, even if it was the picture of the sensitive material photoed under the different-species light source can be obtained, by printing using these light source difference adjustment concentration data, there is no tint and the print of the proper quality of image which maintained gray balance can be obtained.

[0018] In this invention, if it is not limited to the negative color film mentioned above but the distortion of the color reproduction by the interlayer effect arises in the photography under the different-species light source, what sensitive material is sufficient as the target sensitive material, and it can mention various sensitive films, such as other, for example, a color, reversal films [negative color film / which was mentioned above], monochrome negative film, and monochrome reversal film.

[0019] Moreover, when the proper light source photos a photographic subject with proper light exposure to sensitive material in this invention, it is the light source which can be photoed so that both gray balance and a color reproduction may be finished proper and negatives can be developed, and is decided according to sensitive material. On the other hand, the different-species light source [light source / proper] shifted says all the light sources other than the proper light source to the photographic subject photography specified to sensitive material. For example, although the light source with high color temperature, a fluorescent lamp, the tungsten light source, etc. can be mentioned in the case of a common sensitive material for the daylights, even if it is the daylight, when days, such as cloudiness, also have high color temperature, it can treat as the different-species light source. Moreover, it is necessary to also treat the light sources other than specification, and the usual daylight as the different-species light source with sensitive material by that the special photography light source is specified to be.

[0020] Moreover, 3DLUT for changing into concentration data before receiving an interlayer effect the picture concentration data recorded with the scanner etc. from sensitive material in the 1st conversion process of this invention and the 2nd inverse transformation process What is necessary is not to be used similarly, and just to set up suitably according to sensitive material especially, rather than to to be restrictive, when transforming inversely concentration data without the interlayer effect of a light source difference adjustment to the picture concentration data which have an interlayer effect by the light source difference adjustment and which are equivalent to photography under the proper light source.

[0021] Such a 3DLUT can be created as follows, for example. First, it exposes to sensitive material, for example, a negative color film, in the combination of each color two or more level, for example, 9 level, by very sharp R, G, and B light (for example, laser beam). Then, the color patch of 726 (=9x9x9) individuals is generated. There are nine things exposed only with R light in these color patches. Since G light and B light have not shone upon this color patch, G layers and B horizon of this sensitive material have not exposed, and a development restrainer is not emitted. Therefore, R layers of this sensitive material are not influenced of the interlayer effect from other layers, but development progresses. That is, it can be considered that these nine color patches are the concentration in front of an interlayer effect (it is the meaning of not being influenced of the interlayer effect from other layers). Here, DR0j [the concentration data] (j=1-9) is written. Moreover, when exposed only with G light and B light, it is the same, and it writes DG0j and DB0j [those concentration data].

[0022] the concentration data in front of the interlayer effect of the color patch upon which R, G, and B light shone simultaneously being DR0j, DG0j, and DB0j, respectively, and carrying out density measurement of the concentration (it also being hereafter called negative concentration) data after an interlayer effect (meaning of being influenced of the interlayer effect from other layers) -- DRj, DGj, and DBj ***** -- it is obtained In this way, they are the negative concentration data DRj, DGj, and DBj about all the color patches of 726 colors. The pair of concentration data DR0j in front of an interlayer effect, DG0j, and DB0j is constituted. It is 3DLUT for this changing negative concentration into the concentration in front of an interlayer

effect. Since this 3DLUT is used also for transforming inversely the concentration in front of the interlayer effect to which the light source difference was adjusted to negative concentration, it can be called bidirectional data-conversion means of negative concentration and the concentration in front of an interlayer effect.

[0023] By using such a 3DLUT, they are the arbitrary negative concentration data DRi, DRi, and DBi. An input outputs concentration data DR0i in front of an interlayer effect, DG0i, and DB0i by performing a **** operation. On the contrary, when concentration data DR1i in front of arbitrary interlayer effects, DG1i, and DB1i are inputted, they are negative concentration data DR'i, DR'i, and DB'i by performing a **** operation similarly. It is outputted.

[0024] Although 3DLUT is used in the example of illustration as 1st bidirectional data-conversion means which performs the inverse transformation while changing the concentration (negative concentration) of sensitive material into the concentration in front of an interlayer effect, as long as this invention is not limited to this but can perform bidirectional conversion between the concentration of sensitive material, and the concentration in front of an interlayer effect, what thing is sufficient as it. However, since all serve as nonlinear conversion, although such order conversion and inverse transformation have most desirable 3DLUT in respect of precision as follows, for example, a matrix operation etc. can be used instead of this 3DLUT.

Order conversion DR0 i=fR (DRi, DGi, and DBi)

DG0i=fG (DRi ,DGi ,DBi)

DB0i=fB (DRi ,DGi ,DBi)

Inverse transformation DRi =gR (DR0i, DG0i, DB0i)

DGi =gG (DR0i,DG0i,DB0i)

DBi =gB (DR0i,DG0i,DB0i)

Here, DR0i, DG0i, and DB0i are the concentration data in front of an interlayer effect, DRi, DGi, and DBi. The concentration of sensitive material, fR, fG, and fB An order transform function, gR, gG, and gB An inverse transformation function is expressed.

[0025] Thus, 3DLUT used by this invention can be approximated by 3x3 matrices shown below. In addition, since 3DLUT showing an interlayer effect generally has strong non-linearity as mentioned above, priority is given to the speed of data processing, and although the precision is considered not to be not much good, the approximation by this matrix can be used when precision is seldom required.

[0026]

[Equation 1]

$$\begin{vmatrix} DR_{0i} \\ DG_{0i} \\ DB_{0i} \end{vmatrix} = \begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix} \begin{vmatrix} DR_i \\ DG_i \\ DB_i \end{vmatrix}$$

[0027] moreover, the 2nd conversion process of this invention and the 1st inverse transformation process -- setting -- the concentration data in front of an interlayer effect -- a logarithm -- what is necessary is not to use similarly three 1DLUT(s) for changing into light exposure data, and they not to be restrictive and just to set them up suitably according to sensitive material especially, when it corresponds to the characteristic curve of sensitive material, for example, a negative color film, and transforms inversely light source difference adjustment light exposure data to the concentration data in front of an interlayer effect of a light source difference adjustment

[0028] Such 1DLUT can be created as follows, for example. First, the proper light source performs the sensitometry of a gray to sensitive material, such as a negative film, and sensitive-material samples, such as a negative sample, are obtained. It obtains by carrying out density measurement of this sample, the concentration, i.e., the negative concentration, of sensitive material. By making above-mentioned 3DLUT act on this negative concentration, the concentration in front of an interlayer effect is obtained. since light exposure (logarithm light exposure) is known -- a logarithm -- 1DLUT can be set up between light exposure and the concentration in front of an interlayer effect

[0029] the example of illustration -- the concentration in front of an interlayer effect -- a

logarithm -- although 1DLUT is used as 2nd bidirectional data-conversion means which performs the inverse transformation while changing into light exposure, this invention is limited to this -- not having -- the concentration in front of an interlayer effect, and a logarithm -- what thing may be used as long as it can perform bidirectional conversion between light exposure in addition, the concentration in front of these interlayer effects and a logarithm -- since the relation between light exposure is expressed by the characteristic curve of sensitive material, it can use polynomial approximation etc. instead of 1DLUT mentioned above

[0030] Moreover, in the light source difference adjustment process of this invention, the difference in the photography light source of the proper light source and the different-species light source is adjusted. Or the picture of the sensitive material photoed under the proper light source of an amendment sake What is necessary is for especially the difference of the light exposure of (calling it hereafter a proper light source photography picture) and the light exposure of the picture (henceforth a different-species light source photography picture) of the sensitive material photoed under the different-species light source not to be restrictive, and just to set it up suitably according to the target different-species light source and the proper light source decided to sensitive material. In addition, as for the difference of this light exposure, it is desirable that it is a light exposure difference when seeing the proper light source and the different-species light source by the light exposure difference when the spectral sensitivity of sensitive material estimates, and the eye of the so-called sensitive material.

[0031] The difference of such light exposure can be set up as follows, for example. First, LATD of a different-species light source photography picture and LATD of a proper light source photography picture 1DLUT for light exposure conversion which changed into the concentration data in front of an interlayer effect using 3DLUT for interlayer effect removal mentioned above, and was further mentioned above -- a logarithm, after changing into light exposure data It can ask for light exposure difference deltaE (deltalogER, deltalogEG, deltalogEB) by calculating both difference to each colors R and G and every B. In addition, when the different-species light source which may be used for photography at sensitive material and a photography proper light source row is known, a light exposure difference can also be beforehand set up by photoing the proper light source and two or more different-species light sources to sensitive material, calculating LATD of the different-species light source and the proper light source for every different-species light source, and searching for the light exposure difference by the above-mentioned method. By carrying out like this, the simplification of processing of the color-correction method of this invention and improvement in processing speed can be aimed at.

[0032] the example of illustration -- a logarithm, although a means to add the difference of the light exposure based on LATD of a proper light source photography picture and the light exposure based on LATD of a different-species light source photography picture by making into adjustment or an amendment means a gap of the light exposure of the proper light source and the different-species light source which are adjusted in light exposure is used this invention is limited to this -- not having -- the gap with the light exposure of a proper light source photography picture, and the light exposure of a different-species light source photography picture -- an amendment -- what thing may be used as long as things are made In addition, the light exposure difference of a different-species light source photography picture may not be limited to the thing based on LATD of both pictures, for example, may be proper and a thing based on the median of the gray level histogram of both pictures, the highest concentration value of both pictures, etc. The color-correction method of this invention is constituted as mentioned above fundamentally.

[0033] Such a color-correction method of this invention can be enforced according to one example of the color-correction equipment of this invention shown in drawing 2 . Drawing 2 is the block diagram showing one example of the digital photograph printer which applies the color-correction equipment of this invention.

[0034] The scanner 12 which reads in photoelectricity the picture with which the digital photograph printer 10 shown in this drawing was supported by sensitive material, such as a negative color film, (picture reader), It not only performs the color-correction method of this invention to the picture concentration data read with the scanner 12, but have color-correction

equipment 14 of this invention, and it performs a necessary image processing. The image processing system 16 made into the image data for image recording, A print picture is made into a latent image at sensitive material for a print, such as printing paper, using light beams, such as a laser beam modulated based on the image data for image recording outputted from the image processing system 16. It has image recording equipment (printer) 22 which a print picture equips with the sensitive-material processor 20 which carries out the development of the sensitive material for a print, such as printing paper recorded as a latent image, by the picture aligner 18 and the picture aligner 18 to record.

[0035] The 1st transducer 24 for performing bidirectional data conversion between concentration data before the color-correction equipment 14 of this invention receives the concentration data and the interlayer effect which were read from the picture photoed by sensitive material, such as a negative film, with the scanner 12 in photoelectricity, It has the 2nd transducer 26 which performs bidirectional data conversion between concentration data before receiving this interlayer effect, and light exposure data, and the controller 28 which adjusts a gap of the light exposure of the proper light source and the different-species light source in the aforementioned light exposure data.

[0036] The 1st transducer 24 also performs the inverse transformation while changing concentration data, such as negative concentration, into the concentration data in front of an interlayer effect, and it has 3DLUT, 3x3 matrices, etc. which were mentioned above. The 2nd transducer 26 also performs the inverse transformation while changing the concentration data in front of an interlayer effect into light exposure data, and it has 1DLUT, a polynomial, etc. corresponding to a characteristic curve of sensitive material which were mentioned above. As it is adjustment or an amendment thing and the gap of the light exposure of the proper light source and the different-species light source was mentioned above, a controller 28 adds the light exposure difference of LATD of a proper light source photography picture and a different-species light source photography picture to the light exposure data of a different-species light source photography picture, and has the operation means which the light exposure data of a proper light source photography picture are made to shift.

[0037] In addition, in the digital photograph printer 10 of the example of illustration, the sensitive-material processor 20 can apply a thing that it is not restrictive and conventionally well-known to the picture aligner 18 row of the image processing system 16 except a scanner 12 and the color-correction equipment 14 of this invention, and image recording equipment 22 especially.

[0038] In the digital photograph printer 10 of the example of illustration, first, after the concentration data of the different-species light source photography picture of sensitive material are read with a scanner 12, it is sent to an image processing system 16. In an image processing system 16, after performing necessary various well-known image processings to this (an interlayer effect is included) concentration data if needed, it is sent to the color-correction equipment 14 of this invention.

[0039] In the color-correction equipment 14 of this invention, the concentration (interlayer effect is included) data with which the image processing necessary by the 1st transducer 24 was performed first are changed into the concentration data in front of an interlayer effect using the above-mentioned 3DLUT. Next, the concentration data in front of this interlayer effect are changed into light exposure data using the above-mentioned 1DLUT by the 2nd transducer 26.

[0040] Then, the light exposure difference of the different-species light source and the proper light source is added to this light exposure data by the controller 28, and it is made to shift to the adjustment light exposure data of the proper light source. Then, the obtained adjustment light exposure data are again returned to the 2nd transducer 26, and it transforms inversely to the adjusted concentration data in front of an interlayer effect. Furthermore, it returns and transforms inversely to concentration data re-**** 1 transducer 24 in front of an interlayer effect of the obtained adjustment, and concentration data equivalent to the concentration (interlayer effect is included) data of the picture of the sensitive material photoed under the proper light source can be obtained.

[0041] In this way, in an image processing system 16, after necessary various well-known image

processings are performed if needed and the obtained concentration data are used as the picture concentration data for image recording, they are sent to the picture aligner 18 of image recording equipment 22 from an image processing system 16. In the picture aligner 18, a print picture is recorded on sensitive material, such as printing paper, as a latent image by light beams, such as a laser beam modulated based on the picture concentration data for image recording. Finally in the sensitive-material processor 20, the development of the print picture recorded on sensitive material as a latent image can be carried out in the sensitive-material processor 20, and a result print can be obtained. In this way, by being finished, even if a print is photoed with the different-species light source, it can make the picture of quality of image equivalent to the obtained thing which was photoed with the proper light source to both gray balance and a color reproduction. The color-correction equipment of this invention is constituted as mentioned above fundamentally.

[0042] As mentioned above, although various examples were given and the color-correction method and equipment concerning this invention were explained in detail, in the range which this invention is not limited to the above-mentioned example, and does not deviate from the summary of this invention, various kinds of improvement is performed and, of course, a change of a design may be made.

[0043]

[Effect of the Invention] As explained in full detail above, when gray balance is maintained and printed from sensitive material, such as a negative film photoed with the different-species light source, according to this invention, the degree of color can also be restored remarkably and the print in which both the gray balance and color reproductions near a print from sensitive material, such as a negative film by which the proper light source was carried out, also have a proper picture can be obtained.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the flow chart of an example of the color-correction method concerning this invention.
[Drawing 2] It is the block diagram of one example of the digital photograph printer by which the color-correction equipment of this invention which enforces the color-correction method shown in drawing 1 is applied.
[Description of Notations]
10 Digital Photograph Printer
12 Scanner
14 Color-Correction Equipment
16 Image Processing System
18 Picture Aligner
20 Sensitive-Material Processor
22 Image Recording Equipment
24 1st Transducer
26 2nd Transducer
28 Controller

[Translation done.]

(54)【発明の名称】　色補正方法および装置

(57)【要約】

【課題】適正光源から著しくはずれた異種光源で撮影されたネガフィルムなどの感光材料から、グレイバランスと色再現が共に適切に補正されたプリントを得ることができる色補正方法および装置を提供する。

【解決手段】感光材料に撮影された画像から光電的に読み込まれた濃度データを重層効果を受ける前の濃度データに変換する第1変換工程と、変換された濃度データを露光量データに変換する第2変換工程と、変換された露光量データにおいて適正光源と異種光源との露光量のずれを調整する工程と、こうして得られた調整露光量データに第2変換工程の逆変換を行って濃度データを得る第1逆変換工程と、この逆変換された濃度データに第1変換工程の逆変換を行って適正光源で撮影された感光材料を読み込んだ時に得られる濃度データと同等の濃度データを得る第2逆変換工程とを有することにより、上記課題を解決する。

1
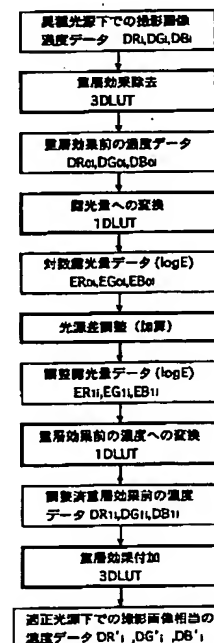
【特許請求の範囲】

【請求項１】感光材料に撮影された画像から光電的に読み込まれた濃度データを重層効果を受ける前の濃度データに変換する第１変換工程と、変換された濃度データを露光量データに変換する第２変換工程と、変換された露光量データにおいて適正光源と異種光源との露光量のずれを調整する工程と、こうして得られた調整露光量データに前記第２変換工程の逆変換を行って濃度データを得る第１逆変換工程と、この逆変換された濃度データに前記第１変換工程の逆変換を行って前記適正光源で撮影された感光材料を読み込んだ時に得られる濃度データと同等の濃度データを得る第２逆変換工程とを有することを特徴とする色補正方法。

【請求項２】前記第１変換工程および第２逆変換工程は、同一の３次元ルックアップテーブルを用いることを特徴とする請求項１に記載の色補正方法。

【請求項３】前記第２変換工程および第１逆変換工程は、前記感光材料の特性曲線に対応する同一の１次元ルックアップテーブルを用いることを特徴とする請求項１または２に記載の色補正方法。

【請求項４】前記露光量のずれは、前記適正光源と前記異種光源との露光量差である特徴とする請求項１～３のいずれかに記載の色補正方法。

【請求項５】前記露光量差は、前記適正光源と前記異種光源とを前記感光材料の分光感度に基づいて評価した時の露光量差である特徴とする請求項４に記載の色補正方法。

【請求項６】感光材料に撮影された画像から光電的に読み込まれた濃度データと重層効果を受ける前の濃度データとの間の双方向データ変換を行う第１変換手段と、前記重層効果を受ける前の濃度データと露光量データとの間の双方向データ変換を行う第２変換手段と、前記露光量データにおいて適正光源と異種光源の露光量のずれを調整する手段とを有し、

前記読み込まれた濃度データを前記第１変換手段および前記第２変換手段によって前記重層効果を受けていない前記露光量データに変換し、得られた露光量データにおいて前記調整手段によって前記露光量のずれを調整し、こうして得られた調整露光量データに前記第２変換手段および第１変換手段による逆変換を順次行って、前記適正光源で撮影された前記カラー感光材料を読み込んだ時に得られる濃度データと同等の濃度データを得ることを特徴とする色補正装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、ネガフィルムなどの感光材料に適正光源からずれた異種光源で撮影された画像から適正光源で撮影された画像のようにグレイバランスのとれた画像、特にカラー画像が良好に再現されたプリントを得るための色補正方法および装置に関する。

【０００２】

【従来の技術】通常、カラーネガフィルムなどの感光材料は、適正光源に対して色再現が最適になるように重層効果の設計がなされている。従って、適正光源下において適正露光で感光材料に撮影されたカラー画像を通常のフォトプリンタでプリントする場合には、グレイバランスのとれた色再現の最適なプリント画像を得ることができる。

【０００３】しかしながら、適正光源から著しくはずれた異種光源、例えば色温度の高い光源、蛍光灯、極端な場合にはタングステン光源などに対しては、この前提がくずれ、このような異種光源でカラーネガフィルムなどの感光材料に撮影した場合、色によって重層効果がかかりすぎたりして、撮影された画像を再現する際に色再現がゆがんでしまうのが普通である。このため、異種光源下で撮影された画像をそのまま再現すると、例えば、タングステン光源で撮影された画像では赤味が強く、蛍光灯で撮影された画像では緑味が強いなどの色味の強いプリントが得られる。このようなプリントは、特別な異種光源に限られず、例えば曇りなどの日でも色温度が高い場合には、同様に起こり、撮影画像をそのまま再現すると青味の強いプリントが得られる。

【０００４】このため、従来技術では撮影画像の大面積透過濃度（ＬＡＴＤ）等の方式でプリントの色味を補正することが行われている。すなわち異種光源下の撮影画像のＬＡＴＤを適正光源下の撮影画像のＬＡＴＤとを比較し、プリントでの色味のずれの分だけシフトさせることにより、プリントの色味を補正することが行われている。しかしながら、このような従来技術でグレイバランスのとれたプリントを作成した場合、グレイにとっては丁度よい補正であっても、個々の色にとっては補正が強すぎたり、または弱すぎたりして満足な色再現が得られないことになる。

【０００５】すなわち、アナログプリンタでは、ハイライトからシャドウまでの全体がシフトするので、その中間のグレイ領域ではグレイバランスをとることができる。しかしながら、アナログプリンタでは階調変更ができないため、ハイライト領域やシャドウ領域では色味を完全になくすことができず、ハイライトからシャドウまでグレイバランスのとれたプリントを得ることが困難である。一方、デジタルプリンタでは、画素毎の処理ができ、階調変更が可能であるため、色温度の高い光源や蛍光灯などの異種光源下で撮られたカラー画像であっても、ハイライトからシャドウまでの全域でグレイバランスのとれたプリントを得ることは比較的容易にできるが、色再現は、うまく補正できず、例えば、赤色が暗く沈んだ色に再現されてしまう等の欠点があった。

【０００６】

【発明が解決しようとする課題】本発明の目的は、上記従来技術の問題点を解消し、適正光源から著しくはずれ

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た異種光源で撮影されたネガフィルムなどの感光材料から、グレイバランスと色再現が共に適切に補正されたプリントを得ることができる色補正方法および装置を提供することにある。

【０００７】
【課題を解決するための手段】上記目的を解決するために、本発明は、感光材料に撮影された画像から光電的に読み込まれた濃度データを重層効果を受ける前の濃度データに変換する第１変換工程と、変換された濃度データを露光量データに変換する第２変換工程と、変換された露光量データにおいて適正光源と異種光源との露光量のずれを調整する工程と、こうして得られた調整露光量データに前記第２変換工程の逆変換を行って濃度データを得る第１逆変換工程と、この逆変換された濃度データに前記第１変換工程の逆変換を行って前記適正光源で撮影された感光材料を読み込んだ時に得られる濃度データと同等の濃度データを得る第２逆変換工程とを有することを特徴とする色補正方法を提供するものである。

【０００８】ここで、前記第１変換工程および第２逆変換工程は、同一の３次元ルックアップテーブルを用いるのが好ましい。また、前記第２変換工程および第１逆変換工程は、前記感光材料の特性曲線に対応する同一の１次元ルックアップテーブルを用いるのが好ましい。また、前記露光量のずれは、前記適正光源と前記異種光源との露光量差であるのが好ましく、この露光量差は、前記適正光源と前記異種光源とを前記感光材料の分光感度に基づいて評価した時の露光量差であるのが好ましい。

【０００９】また、本発明は、感光材料に撮影された画像から光電的に読み込まれた濃度データと重層効果を受ける前の濃度データとの間の双方向データ変換を行う第１変換手段と、前記重層効果を受ける前の濃度データと露光量データとの間の双方向データ変換を行う第２変換手段と、前記露光量データにおいて適正光源と異種光源の露光量のずれを調整する手段とを有し、前記読み込まれた濃度データを前記第１変換手段および前記第２変換手段によって前記重層効果を受けていない前記露光量データに変換し、得られた露光量データにおいて前記調整手段によって前記露光量のずれを調整し、こうして得られた調整露光量データに前記第２変換手段および第１変換手段による逆変換を順次行って、前記適正光源で撮影された前記カラー感光材料を読み込んだ時に得られる濃度データと同等の濃度データを得ることを特徴とする色補正装置を提供するものである。

【００１０】
【発明の実施の形態】本発明に係る色補正方法および装置を添付の図面に示す好適実施形態に基づいて以下に詳細に説明する。

【００１１】本発明の特徴とする処は、スキャナなどの画像読取装置でカラーネガフィルムなどの感光材料から得られる画像情報（濃度データ）を重層効果を受ける前

４

の状態に変換して光源の差異を補正することにある。この重層効果を受ける前の状態では、光源の差異、特に適正光源と異種光源との差異は、容易に補正でき、例えば両光源を感光材料の分光感度で見たときの露光量差を全画像情報（全濃度データ）に加えることにより補正できる。こうして、重層効果を受ける前の状態で光源の差異を補正した後、異種光源の環境から適正光源の環境に引き戻して、再び重層効果を施すことにより、異種光源下での撮影に起因する色味をなくし、グレイバランスと色再現がともに適切に補正されたプリントを得ることができる。

【００１２】図１は、本発明に係る色補正方法の一例を示すフローチャートである。同図に示すように、本発明の色補正方法では、まず第１の変換工程において、異種光源下で感光材料に撮影された画像から、スキャナなどの画像読取装置で光電的に読み込まれた濃度データ（DR_i，DG_i，DB_i）を、下記のように重層効果を除くための３次元ルックアップテーブル（以下、３ＤＬＵＴという）で変換（Φ_{3D}）して、重層効果が除去された重層効果を受ける前の状態の濃度データ（DR_{0i}，DG_{0i}，DB_{0i}）を得る。

（DR_i，DG_i，DB_i）→Φ_{3D}→（DR_{0i}，DG_{0i}，DB_{0i}）

ここで、変換Φ_{3D}は３ＤＬＵＴ変換を表す。

【００１３】次に、第２の変換工程において、こうして得られた重層効果前の濃度データ（DR_{0i}，DG_{0i}，DB_{0i}）を、下記のように色（R，G，B）毎に３つの露光量変換用１次元ルックアップテーブル（以下、１ＤＬＵＴという）を用いてそれぞれ変換（Φ_R，Φ_G，Φ_B）して、対数露光量データ（$\log ER_{0i}$，$\log EG_{0i}$，$\log EB_{0i}$）を得る。

$\log ER_{0i}$→Φ_R→DR_{0i}
$\log EG_{0i}$→Φ_G→DG_{0i}
$\log EB_{0i}$→Φ_B→DB_{0i}

ここで、Φ_R，Φ_G，Φ_Bは、それぞれ各色R，G，Bの１ＤＬＵＴ変換を表す。

【００１４】続いて、光源差調整工程において、こうして得られた対数露光量データ（$\log ER_{0i}$，$\log EG_{0i}$，$\log EB_{0i}$）に、下記のように各色（R，G，B）毎に異種光源と適正光源との露光量差を加えて、適正光源下での撮影に相当する、調整された新規な対数露光量データ（$\log ER_{1i}$，$\log EG_{1i}$，$\log EB_{1i}$）に変換する。

$\log ER_{1i} = \log ER_{0i} + \Delta \log ER$
$\log EG_{1i} = \log EG_{0i} + \Delta \log EG$
$\log EB_{1i} = \log EB_{0i} + \Delta \log EB$

ここで、$\Delta \log ER$，$\Delta \log EG$，$\Delta \log EB$は、それぞれ各色R，G，Bの異種光源と適正光源との露光量差を表す。

【００１５】次に、第１の逆変換工程において、こうし

て得られた光源差調整済の対数露光量データ（$\log ER_{11}$，$\log EG_{11}$，$\log EB_{11}$）を、上述した露光量への変換に用いた３つの露光量変換用１ＤＬＵＴ（Φ_R，Φ_G，Φ_B）を再び用いてそれぞれ逆変換して、光源差調整済の、重層効果のない濃度データ（DR_{11}，DG_{11}，DB_{11}）を得る。

$$DR_{11} \to {}^{t}\Phi_R \to \log ER_{11}$$
$$DG_{11} \to {}^{t}\Phi_G \to \log EG_{11}$$
$$DB_{11} \to {}^{t}\Phi_B \to \log EB_{11}$$

ここで、${}^{t}\Phi_R$，${}^{t}\Phi_G$，${}^{t}\Phi_B$は、それぞれ各色Ｒ，Ｇ，Ｂの１ＤＬＵＴ逆変換を表す。

【００１６】最後に、第２の逆変換工程において、こうして得られた光源差調整済の、重層効果のない濃度データ（DR_{11}，DG_{11}，DB_{11}）を、上述した重層効果除去に用いた３ＤＬＵＴ（Φ_{30}）を再び用いて逆変換して、光源差調整済で重層効果のある、すなわち適正光源下で撮影に相当する画像濃度データ（DR'_1，DG'_1，DB'_1）を得る。

$$(DR_{11}, DG_{11}, DB_{11}) \to {}^{t}\Phi_{30} \to (DR'_1, DG'_1, DB'_1)$$

ここで、変換${}^{t}\Phi_{30}$は、３ＤＬＵＴ逆変換を表す。

【００１７】こうして、異種光源下で撮影された感光材料の画像であっても、適正光源下で撮影された感光材料の画像を読み込んだ時に得られる濃度データと同等の濃度データを得ることができ、これらの光源差調整濃度データを用いてプリントすることにより、色味がなく、グレイバランスのとれた適正な画質のプリントを得ることができる。

【００１８】本発明において、対象とする感光材料は、上述したカラーネガフィルムに限定されず、異種光源下での撮影で重層効果による色再現のゆがみが生じるものであれば、どのような感光材料でもよく、上述したカラーネガフィルムの他、例えばカラーリバーサルフィルム、黒白ネガフィルム、黒白リバーサルフィルムなどの種々の感光フィルムを挙げることができる。

【００１９】また、本発明において適正光源とは、感光材料に被写体を適正な露光量で撮影する時、グレイバランスおよび色再現がともに適正に仕上がるように現像できるように撮影することのできる光源であり、感光材料に応じて決められる。一方、適正光源からずれた異種光源とは、感光材料に対して特定される被写体撮影に適正な光源以外の全ての光源をいう。例えば、一般的な昼光用感光材料の場合、色温度の高い光源、蛍光灯、タングステン光源などを挙げることができるが、昼光であっても、曇りなどの日でも色温度が高い場合には異種光源として扱うことができる。また、感光材料によって、特殊な撮影光源が指定されているものでは、指定以外の光源、通常の昼光も異種光源として扱う必要がある。

【００２０】また、本発明の第１の変換工程および第２の逆変換工程において、感光材料からスキャナなどで収録された画像濃度データを重層効果を受ける前の濃度データに変換するための３ＤＬＵＴは、光源差調整済の、重層効果のない濃度データを光源差調整済で重層効果のある、適正光源下で撮影に相当する画像濃度データに逆変換する場合にも、同様に用いられるものであり、特に制限的ではなく、感光材料に応じて適宜設定すればよい。

【００２１】このような３ＤＬＵＴは、例えば、以下のようにして作成することができる。まず、非常にシャープなＲ，Ｇ，Ｂ光（例えば、レーザ光）で、各色複数レベル、例えば９レベルの組み合わせで、感光材料、例えばカラーネガフィルムに露光する。すると、７２６（＝９×９×９）個の色パッチが生成される。これらの色パッチの中には、Ｒ光のみで露光されたものが９つある。この色パッチにはＧ光、Ｂ光はあたっていないので、この感光材料のＧ層およびＢ層は未感光であり、現像抑制剤が放出されない。従って、この感光材料のＲ層は、他層からの重層効果の影響を受けず現像が進む。すなわち、この９つの色パッチは、重層効果前（他層からの重層効果の影響を受けていないという意味である）の濃度と見なすことができる。ここでは、その濃度データをDR_{0j}（$j=1\sim9$）と表記する。また、Ｇ光のみ、およびＢ光のみで露光された場合も同様であり、それらの濃度データをDG_{0j}、およびDB_{0j}と表記する。

【００２２】Ｒ，Ｇ，Ｂ光が同時にあたった色パッチの重層効果前の濃度データは、それぞれDR_{0i}，DG_{0i}，DB_{0i}であり、重層効果後（他層からの重層効果の影響を受けているという意味）の濃度（以下、ネガ濃度とも呼ぶ）データは、濃度測定することにより、DR_i，DG_i，DB_iとして得られる。こうして、７２６色の全ての色パッチについて、ネガ濃度データDR_i，DG_i，DB_iと重層効果前の濃度データDR_{0i}，DG_{0i}，DB_{0i}の対が、構成される。これがネガ濃度を重層効果前の濃度に変換するための３ＤＬＵＴである。この３ＤＬＵＴは、光源差が調整された重層効果前の濃度をネガ濃度に逆変換するのにも用いられるので、ネガ濃度と重層効果前の濃度との双方向データ変換手段ということができる。

【００２３】このような３ＤＬＵＴを用いることにより、任意のネガ濃度データDR_i，DR_i，DB_iが入力されると、補間演算を行うことにより重層効果前の濃度データDR_{0i}，DG_{0i}，DB_{0i}が出力される。逆に、任意の重層効果前の濃度データDR_{11}，DG_{11}，DB_{11}が入力されると、同様に補間演算を行うことによりネガ濃度データDR'_1，DR'_1，DB'_1が出力される。

【００２４】図示例では、感光材料の濃度（ネガ濃度）を重層効果前の濃度に変換するとともにその逆変換を行う第１の双方向データ変換手段として、３ＤＬＵＴを用いているが、本発明はこれに限定されず、感光材料の濃

7

度と重層効果前の濃度との間の双方向変換を行うことができるものであれば、どのようなものでもよい。しかし、これらの順変換および逆変換は、下記のように、いずれも非線形変換となるので、精度の点で3DLUTが最も好ましいが、この3DLUTの代わりに、例えば、マトリックス演算なども用いることができる。

順変換

$DR_{oi} = f_R (DR_i, DG_i, DB_i)$
$DG_{oi} = f_G (DR_i, DG_i, DB_i)$
$DB_{oi} = f_B (DR_i, DG_i, DB_i)$

逆変換

$DR_i = g_R (DR_{oi}, DG_{oi}, DB_{oi})$
$DG_i = g_G (DR_{oi}, DG_{oi}, DB_{oi})$
$DB_i = g_B (DR_{oi}, DG_{oi}, DB_{oi})$

ここで、DR_{oi}, DG_{oi}, DB_{oi} は重層効果前の濃度データ、DR_i, DG_i, DB_i は感光材料の濃度、f_R, f_G, f_B は順変換関数、g_R, g_G, g_B は逆変換関数を表す。

【0025】このように、本発明で用いられる3DLUTは、以下に示す3×3マトリックスで近似することができる。なお、重層効果を表す3DLUTは、上述したように、一般に非線型性が強いので、このマトリックスによる近似は、その精度があまり良くないと考えられるが、演算処理の速度が優先され、精度があまり要求されない場合に用いることができる。

【0026】

【数1】

$$\begin{vmatrix} DR_{oi} \\ DG_{oi} \\ DB_{oi} \end{vmatrix} = \begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix} \begin{vmatrix} DR_i \\ DG_i \\ DB_i \end{vmatrix}$$

【0027】また、本発明の第2の変換工程および第1の逆変換工程において、重層効果前の濃度データを対数露光量データに変換するための3つの1DLUTは、感光材料、例えばカラーネガフィルムの特性曲線に対応するものであり、光源差調整済露光量データを光源差調整済の、重層効果前の濃度データに逆変換する場合にも、同様に用いられるものであり、特に制限的ではなく、感光材料に応じて適宜設定すればよい。

【0028】このような1DLUTは、例えば、以下のようにして作成することができる。まず、適正光源でグレイのセンシトメトリーをネガフィルムなどの感光材料に行い、ネガサンプルなどの感光材料サンプルを得る。このサンプルを濃度測定することにより、感光材料の濃度、すなわちネガ濃度を得る。このネガ濃度に上述の3DLUTを作用させることにより、重層効果前の濃度を得る。露光量（対数露光量）は既知であるので、対数露光量と重層効果前の濃度の間に1DLUTを設定することができる。

【0029】図示例では、重層効果前の濃度を対数露光

8

量に変換するとともにその逆変換を行う第2の双方向データ変換手段として、1DLUTを用いているが、本発明はこれに限定されず、重層効果前の濃度と対数露光量との間の双方向変換を行うことができるものであれば、どのようなものでもよい。なお、これらの重層効果前の濃度と対数露光量との間の関係は、感光材料の特性曲線によって表されるので、上述した1DLUTの代わりに、例えば、多項式近似なども用いることができる。

【0030】また、本発明の光源差調整工程において、適正光源と異種光源との撮影光源の違いを調整、または補正するための適正光源下で撮影された感光材料の画像（以下、適正光源撮影画像という）の露光量と異種光源下で撮影された感光材料の画像（以下、異種光源撮影画像という）の露光量との差は、特に制限的ではなく、対象とする異種光源と感光材料に対して決められている適正光源に応じて適宜設定すればよい。なお、この露光量の差は、適正光源と異種光源とを感光材料の分光感度で評価した時の露光量差、いわゆる感光材料の目で見た時の露光量差であるのが好ましい。

【0031】このような露光量の差は、例えば、以下のようにして設定することができる。まず、異種光源撮影画像のLATDと適正光源撮影画像のLATDとを、上述した重層効果除去用3DLUTを用いて重層効果前の濃度データに変換し、さらに上述した露光量変換用1DLUTで対数露光量データに変換した上で、両者の差を各色R，G，B毎に計算することにより、露光量差ΔE（$\Delta \log ER$, $\Delta \log EG$, $\Delta \log EB$）を求めることができる。なお、予め、感光材料および撮影適正光源ならびに撮影に利用される可能性のある異種光源が既知である場合には、適正光源および複数の異種光源を感光材料に撮影し、異種光源毎に異種光源と適正光源とのLATDを求め、上述の方法により露光量差を求めておくことにより、露光量差を予め設定しておくこともできる。こうすることにより、本発明の色補正方法の処理の簡素化および処理速度の向上をはかることができる。

【0032】図示例では、対数露光量において調整される、適正光源と異種光源の露光量のずれを調整または補正する手段として、適正光源撮影画像のLATDに基づく露光量と異種光源撮影画像のLATDに基づく露光量との差を加算する手段を用いているが、本発明はこれに限定されず、適正光源撮影画像の露光量と異種光源撮影画像の露光量とのずれを補正することができれば、どのようなものでもよい。なお、適正および異種光源撮影画像の露光量差は、両画像のLATDに基づくものに限定されず、例えば、両画像の濃度ヒストグラムの中央値や、両画像の最高濃度値などに基づくものであってもよい。本発明の色補正方法は、基本的に以上のように構成される。

【0033】このような本発明の色補正方法は、図2に示す本発明の色補正装置の一実施例によって実施するこ

とができる。図２は、本発明の色補正装置を適用するデジタルフォトプリンタの一実施例を示すブロック図である。

【００３４】同図に示すデジタルフォトプリンタ１０は、カラーネガフィルムなどの感光材料に担持された画像を光電的に読み取るスキャナ（画像読取装置）１２と、本発明の色補正装置１４を備え、スキャナ１２で読み込まれた画像濃度データに本発明の色補正方法を行うのみならず、所要の画像処理を施して、画像記録用画像データとする画像処理装置１６と、画像処理装置１６から出力された画像記録用画像データに基づいて変調されたレーザビームなどの光ビームを用いて印画紙などのプリント用感光材料にプリント画像を潜像として記録する画像露光装置１８および画像露光装置１８によってプリント画像が潜像として記録された印画紙などのプリント用感光材料を現像処理する感光材料処理装置２０を備える画像記録装置（プリンタ）２２とを有する。

【００３５】本発明の色補正装置１４は、スキャナ１２によってネガフィルムなどの感光材料に撮影された画像から光電的に読み込まれた濃度データと重層効果を受ける前の濃度データとの間の双方向データ変換を行うための第１変換部２４と、この重層効果を受ける前の濃度データと露光量データとの間の双方向データ変換を行う第２変換部２６と、前記露光量データにおいて適正光源と異種光源の露光量のずれを調整する調整部２８とを有する。

【００３６】第１変換部２４は、ネガ濃度などの濃度データを重層効果前の濃度データに変換するとともにその逆変換も行うもので、上述した３ＤＬＵＴや３×３マトリックスなどを有する。第２変換部２６は、重層効果前の濃度データを露光量データに変換するとともにその逆変換も行うもので、感光材料の特性曲線に対応する上述した１ＤＬＵＴや多項式などを有する。調整部２８は、適正光源と異種光源の露光量のずれを調整または補正するもので、上述したように、異種光源撮影画像の露光量データに、適正光源撮影画像と異種光源撮影画像とのＬＡＴＤの露光量差を加算して、適正光源撮影画像相当の露光量データにシフトさせる演算手段を有する。

【００３７】なお、図示例のデジタルフォトプリンタ１０において、スキャナ１２、本発明の色補正装置１４を除く画像処理装置１６および画像記録装置２２の画像露光装置１８ならびに感光材料処理装置２０は、特に制限的ではなく、従来公知のものを適用することができる。

【００３８】図示例のデジタルフォトプリンタ１０においては、まず、スキャナ１２で感光材料の異種光源撮影画像の濃度データが読み込まれた後、画像処理装置１６に送られる。画像処理装置１６においては、この（重層効果を含む）濃度データに、必要に応じて所要の種々の公知の画像処理を施した後、本発明の色補正装置１４に送られる。

【００３９】本発明の色補正装置１４においては、まず第１変換部２４で所要の画像処理が施された（重層効果を含む）濃度データを上記３ＤＬＵＴを用いて重層効果前の濃度データに変換する。次に、第２変換部２６でこの重層効果前の濃度データを上記１ＤＬＵＴを用いて露光量データに変換する。

【００４０】続いて、調整部２８でこの露光量データに異種光源と適正光源との露光量差を加算して、適正光源相当の調整露光量データにシフトさせる。この後、得られた調整露光量データを再び第２変換部２６に戻して、調整済の、重層効果前の濃度データに逆変換する。さらに、得られた調整済の、重層効果前の濃度データ再び第１変換部２４に戻して逆変換し、適正光源下で撮影された感光材料の画像の（重層効果を含む）濃度データと同等の濃度データを得ることができる。

【００４１】こうして得られた濃度データは、画像処理装置１６において、必要に応じて所要の種々の公知の画像処理が施されて、画像記録用画像濃度データとされた後、画像処理装置１６から画像記録装置２２の画像露光装置１８に送られる。画像露光装置１８では、画像記録用画像濃度データに基づいて変調されたレーザビームなどの光ビームによって印画紙などの感光材料に潜像としてプリント画像を記録する。最後に、感光材料処理装置２０において、感光材料に潜像として記録されたプリント画像を感光材料処理装置２０において現像処理して、仕上がりプリントを得ることができる。こうして得られた仕上がりプリントは、異種光源で撮影されたものであっても、グレイバランスも色再現も共に適正光源で撮影されたものと同等の画質の画像に仕上げることができる。本発明の色補正装置は、基本的に以上のように構成される。

【００４２】以上、本発明に係る色補正方法および装置について種々の実施例を挙げて詳細に説明したが、本発明は上記実施例に限定されず、本発明の要旨を逸脱しない範囲において、各種の改良および設計の変更を行ってもよいのはもちろんである。

【００４３】

【発明の効果】以上詳述したように、本発明によれば、異種光源で撮影されたネガフィルムなどの感光材料から、グレイバランスをとってプリントした時に、色彩度も著しく復元することができ、適正光源されたネガフィルムなどの感光材料からのプリントに近い、グレイバランスも色再現も共に適正な画像を持つプリントを得ることができる。

〔図面の簡単な説明〕

【図１】　本発明に係る色補正方法の一例のフローチャートである。

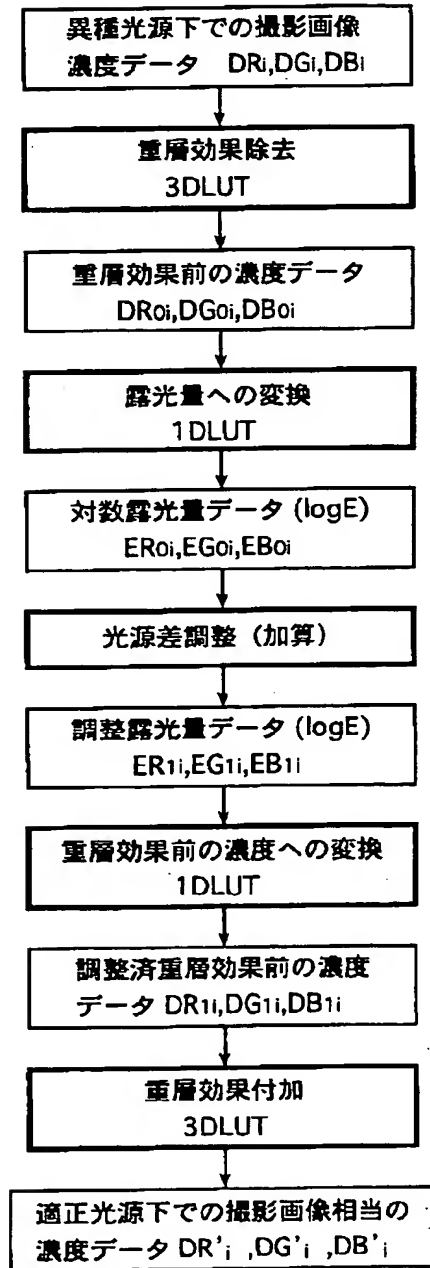【図２】　図１に示す色補正方法を実施する本発明の色補正装置が適用されるデジタルフォトプリンタの一実施例のブロック図である。

11

【符号の説明】
10 デジタルフォトプリンタ
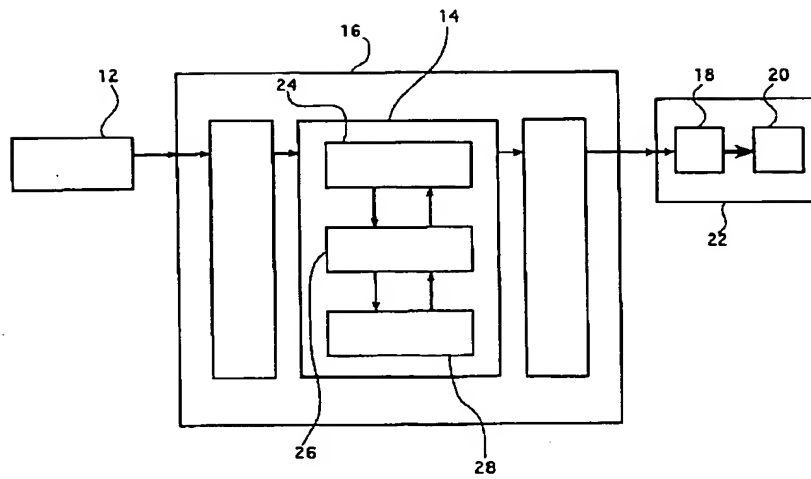12 スキャナ
14 色補正装置
16 画像処理装置
18 画像露光装置

12

＊20 感光材料処理装置
22 画像記録装置
24 第１変換部
26 第２変換部
28 調整部

＊

【図１】

異種光源下での撮影画像
濃度データ DR_i, DG_i, DB_i

↓

重層効果除去
3DLUT

↓

重層効果前の濃度データ
$DR_{oi}, DG_{oi}, DB_{oi}$

↓

露光量への変換
1DLUT

↓

対数露光量データ (logE)
$ER_{oi}, EG_{oi}, EB_{oi}$

↓

光源差調整（加算）

↓

調整露光量データ (logE)
$ER_{1i}, EG_{1i}, EB_{1i}$

↓

重層効果前の濃度への変換
1DLUT

↓

調整済重層効果前の濃度
データ $DR_{1i}, DG_{1i}, DB_{1i}$

↓

重層効果付加
3DLUT

↓

適正光源下での撮影画像相当の
濃度データ DR'_i, DG'_i, DB'_i

【図2】

──

フロントページの続き

Ｆターム(参考)　 2H110 AC14 BA13 BA18 CB33 CB51
　　　　　　　　　　CB55 CB73
　　　　　　　 5C077 MP08 NP01 PP05 PP15 PP16
　　　　　　　　　　PP32 PP37 PP41 PP47 PQ23
　　　　　　　　　　TT03 TT06
　　　　　　　 5C079 HB01 LA12 LA13 LA23 LB01
　　　　　　　　　　MA04 NA03 PA02 PA03 PA08